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| **Scientific Area** | Quantum computing |
| **Topic title** | Entanglement-optimized quantum circuit simulations |
| **Main host institution** | CESQ / ISIS<br>www.cesq.eu |
| **Supervisor/institution** | Johannes Schachenmayer<br>www.schachenmayer.fr |
| **Co-Supervisor/institution** | Wolfgang Wernsdorfer / Karlsruhe Institute of Technology:<br>https://www.phi.kit.edu/english/wernsdorfer.php |
| **Mentor[1]/institution** | TBC |
| **Secondment institution** | TBC |

**Topic description**

The simulation of quantum circuits is an important challenge. Not only can it provide benchmarks (identify a quantum advantage), it can also give fundamental insight into resource requirements and inner workings of algorithms, and physical dynamics. No quantum platform is fully isolated. Therefore, any dynamics of a state is fundamentally open-system dynamics. Recently, we pioneered research on analyzing the complexity in open-system quantum evolution [Phys. Rev. Lett. 129, 170401 (2022), Phys. Rev. A 108, 012616 (2023)]. The goal of this project is to find new entanglement optimized unraveling strategies, based on recent non-unitarity maximization [SciPost Phys. 18, 048 (2025)]. The methodology will be applied to standard quantum circuit components, thus analyzing their classical simulability in noisy environments, and lead to fundamental insights into entanglement of formation in noisy quantum circuits.

**Recommended applicant's profile**

- Master thesis in theoretical physics or a related field
- Strong background in numerical methods
- Programming skills necessary (Julia, C++, Matlab, or Python)
- English proficiency is necessary

[1] Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the DC, including career matters with an external perspective and provide mediation in the case of disputes.

The Gen-Q programme has received funding from the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement number 101217386.